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Original Research

Effects of Extracorporeal Magnetic Wave Pelvic Floor Therapy Combined with PFMT on Pelvic Floor Muscle Strength and Pelvic Organ Prolapse in Patients with Postpartum Pelvic Floor Dysfunction: A Prospective Randomized Trial

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Abstract

Background: To investigate the effect of extracorporeal magnetic wave pelvic floor therapy combined with pelvic floor muscle training (PFMT) on pelvic floor muscle strength and the degree of pelvic organ prolapse in patients with postpartum pelvic floor dysfunction. **Methods**: A total of 100 patients with postpartum pelvic floor dysfunction (PFD) who were treated in Lishui People's Hospital from January 2020 to May 2022 were selected as the research objects. According to the random number table method, they were divided into a control group of 50 cases and an observation group of 50 cases. The control group received pelvic floor muscle training, and the observation group received extracorporeal magnetic wave pelvic floor therapy combined with PFMT on its basis, and the two groups received continuous treatment for 8 weeks. The clinical efficacy; Pelvic floor muscle strength classification; Pelvic organ prolapse quantitative scale (POP-Q) score Ap and C index points; Pelvic floor dysfunction questionnaire (PFDI-20) and Pelvic floor dysfunction questionnaire (PFIQ-7) score were compared between the two groups. **Results**: Compared with the control group (70.00%), the total clinical effective rate (96.00%) of the observation group was significantly increased ($p < 0.05$); compared with before treatment, the proportion of pelvic floor muscle strength of grade 0 in the observation group was significantly decreased, and the proportion of grade IV was significantly increased after treatment, and the proportion of pelvic floor muscle strength of grade 0 in the observation group was significantly lower than that in the control group, and the proportion of grade IV was significantly higher than that in the control group ($p < 0.05$); Compared with before treatment, the POP-Q scores Ap and C index points in the two groups were significantly decreased after treatment, and the POP-Q scores Ap and C index points in the observation group were significantly lower than those in the control group ($p < 0.05$); Compared with before treatment, the PFDI-20 scores and PFIQ-7 scores in the two groups after treatment were significantly decreased, and the PFDI-20 scores and PFIQ-7 scores in the observation group were significantly lower than those in the control group ($p < 0.05$). **Conclusions**: Extracorporeal magnetic wave pelvic floor therapy combined with PFMT can effectively improve the clinical efficacy of PFD patients, improve pelvic floor muscle strength, reduce the degree of pelvic organ prolapse, and improve the quality of life of patients, which has a high clinical reference value. **Clinical Trial Registration**: The study was registered at https://www.chictr.org.cn (registration number ChiCTR1900024783).

Keywords: extracorporeal magnetic wave pelvic floor therapy; pelvic floor muscle training; pelvic floor dysfunction; pelvic floor muscle strength; pelvic organ prolapsed

1. Introduction

Pelvic floor dysfunction (PFD) is a general term for functional deviation of the basin caused by pelvic floor dysfunction and support structure damage. It is mainly manifested as pelvic floor muscle dysfunction and pelvic organ prolapse in clinical [1]. PFD mostly occurs after childbirth because the axis of gravity can move forward during childbirth, which in turn causes the tensile relaxation of pelvic floor muscle collagen fibers and muscles under compression. Research has shown that the biggest issue for the pelvic floor in childbirth has to do with obstetric interventions. During childbirth, vaginal tears can damage the body's pelvic floor nerves, and leading to the relaxation of pelvic floor muscles, which finally progresses to PFD, and has had an impact on the short-term and long-term health and quality of life of women [2,3]. Relevant studies have shown that the probability of postpartum PFD among parturients reaches 15%–42%, and early active and effective rehabilitation treatment is crucial [4]. At present, pelvic floor muscle training (PFMT) is mainly used for the treatment of PFD patients in clinic, and it has played a certain role in improving the situation, but the effect is not very significant. Therefore, other more efficient treatment methods need to be found [5,6]. Extracorporeal magnetic waves use strong pulses generated in the magnetic therapy area to induce depolarization of the pelvic floor nerves, lead-

Table 1. Comparison of two groups of general data.

General material		Control group (n = 50)	Observation group (n = 50)	t/χ^2 value	p value
Average age (years)		29.61 ± 3.43	29.52 ± 3.35	0.372	0.708
Mean gestational weeks (weeks)		39.10 ± 1.18	38.61 ± 1.16	0.459	0.639
Average neonatal weight (g)		3215.61 ± 551.20	3235.23 ± 559.60	0.025	0.994
Delivery mode [n (%)]	Eutocia	29 (58.00)	27 (54.00)	0.473	0.492
	Caesarean	21 (42.00)	23 (46.00)		
Type of complication [n (%)]	Stress urinary incontinence	20 (40.00)	21 (42.00)	0.454	0.501
	Hysteroptosis	13 (26.00)	12 (24.00)		
	Vaginal wall prolapse	17 (34.00)	17 (34.00)		

ing to nerve pulses in the peripheral central nervous system, thereby causing contraction of pelvic floor muscles (including smooth muscle and skeletal muscle) for therapeutic purposes. This method is characterized by non-invasive, painless, convenient and effective use, no significant side effects during treatment, and is more acceptable to patients than electrical stimulation therapy, with better compliance [7]. PFMT is a conservative treatment, which mainly improves the pelvic floor muscle strength by consciously relaxing and constricting the external anal sphincter, levator ani, urethra and other muscle groups. At the same time, it is highly operable and economical [8]. However, there are few studies on the combination of extracorporeal magnetic wave pelvic floor treatment and PFMT, which deserve further study. Therefore, this study is mainly to explore the effects of *in vitro* magnetic wave pelvic floor treatment combined with PFMT on the pelvic floor muscle strength and the degree of pelvic organ prolapse of postpartum PFD patients, in order to provide more reference for the clinical treatment of postpartum PFD.

2. Material and Methods

2.1 General Material

We conducted a prospective randomized controlled study. A total of 100 postpartum PFD patients who visited Lishui People's Hospital from January 2020 to May 2022 were selected as the research subjects. They were divided into a control group (n = 50) and an observation group (n = 50) according to the random number table. The study was registered at https://www.chictr.org.cn (registration number ChiCTR1900024783). The pelvic floor muscle was trained in the control group, and the observation group was additionally treated with *in vitro* magnetic wave pelvic floor therapy combined with PFMT. This study was approved by the Lishui People's Hospital Ethics Committee (Approval number: 20190831LS). There was no significant difference in age, gestational week, neonatal weight, mode of delivery, and complication type between the two groups ($p > 0.05$), and they were comparable, as shown in Table 1.

2.2 Criteria of Inclusion and Exclusion

Inclusion criteria: ① all the patients were diagnosed with postpartum PFD; after physical examination, pelvic examination and quantitative division of pelvic organ prolapse (Pelvic organ Prolapse Quantification, POP-Q) [9]. ② The primiparous women with good uterine involution and clean lochia are returned to hospital after six weeks of vaginal delivery; ③ patients being pregnant and the gestational weeks are 37–42 weeks; ④ patients with normal prenatal pelvic floor function; ⑤ patients with normal heart, liver, kidney and other functions; ⑥ patients or their families signed informed consent.

Exclusion criteria: ① patients with history of pelvic surgery and induced labor; ② patients with urinary and reproductive system infection; ③ patients with complications during pregnancy; ④ patients with chronic diseases such as diabetes, coronary heart disease, and hypertension; ⑤ patients with contraindications to or intolerance to PFMT, extracorporeal magnetic wave pelvic floor treatment, or PFMT.

2.3 Research Methods

PFMT is provided with feedback and guidance from trained and experienced clinicians, such as female health or urological nurse practitioners (NP), physical therapists (PT), to promote and exercise pelvic floor muscles. PFMT was performed in the control group: the patient was asked to empty the bladder, take the patient's supine position, forcibly clamp the vagina and urethra, and forcibly contract the anus for 5–10 s and then relax for 10 s. Afterwards, the operation was repeated and the contraction time was gradually extended to 10 s. During the training, only the pelvic floor muscle was contracted, and the compensatory contraction of the thigh, hip and abdominal muscles was avoided as much as possible, once for 15 min and three times a day.

On the basis of the control group, the observation group underwent extracorporeal magnetic wave pelvic floor treatment in combination with PFMT: ① Neocontrol training system (Huayu Medical Technology (Wuhan) Co., Ltd., Wuhan, Hubei, China) consists of a control unit (providing an operation interface, basic control system, system status, external information, and pulse generator) and a training chair (which is a main part of the training device and can

generate magnetic fields and provide support to patients. Model: Ruiqian X5). The patient seat on the training chair, with the perineum aligned with the magnetic induction coil, and the stimulation intensity set at 15–50 Hz, which was mainly based on the patient's tolerance and bellows movement of both legs, once for 20 min and once every two days. ② PFMT: the patient was instructed to continuously contract the vagina, anus, and perineum for 10 s and then relax, and he/she should be trained at least 120 times a day; Training intermittent urination, that is, pausing during urination or slowing urine flow; take care not to contract the muscles of abdomen, hip and inner thigh when shrinking the anus and perineum; One time for 15–30 min and two–three times a day.

The two groups were treated continuously for 8 weeks.

2.4 Observational Index

① Clinical effect [10]: marked effectiveness: the pelvic floor muscle function was well restored, and the autonomic movement could be carried out without adverse symptoms; Effective: the pelvic floor muscle function is improved, and the patient can exercise properly. Invalid: the above criteria are not met or the condition even deteriorates; total clinical effective rate = markedly effective + effective. ② Pelvic floor muscle strength: the pelvic floor bioelectric feedback stimulation therapeutic apparatus (Shenzhen Keluikang Industrial Co., Ltd., Lupu AM300B, Shenzhen, Guangdong, China) was used to measure the pelvic floor muscle strength of patients in the two groups before and after treatment. The specific operation was to place a muscle potential probe in the vagina to detect the changes of muscle strength. Level 0: the vaginal muscle contraction was maintained for 0 s; Class I: vaginal muscle contraction lasts for 1 s; Class II: vaginal muscle contraction lasts for 2 s; Class III: vaginal muscle contraction lasts for 3 s; Class IV: vaginal muscle contraction lasts for 4 s; Grade V: the vaginal muscle contraction is maintained for at least 5 s, and the lower the grade is, the worse the pelvic floor muscle strength will be. ③ Extent of pelvic organ prolapse: POP-Q scoring was used to score the patients in the former two groups before and after treatment. The measurement position was breathless standing, the reference point was the hymen margin, and one point on the posterior wall (Ap) and the top point (C) of the vagina were taken as the indication points. The changes of these two points relative to the hymen were measured. The values outside the hymen were positive, while those inside the hymen were negative. ④ Quality of life: Pelvic Floor Impact Questionnaire-Short Form 20 (PFDI-20) [11] and Pelvic Floor Impact Questionnaire-Short Form 7 were adopted respectively. PFIQ-7 [12] was used to score the quality of life of patients in the two groups before and after treatment. The lower the PFDI-20 score and PFIQ-7 score, the better the pelvic floor function would be, and the smaller the impact on the body quality of life would be.

2.5 Statistical Methods

Statistical analysis was performed using SPSS 18.0 (IBM Corp., Chicago, IL, USA). The measurement data were expressed as mean standard $\pm$ deviation ($\bar{x} \pm$ s) and tested using t; Enumeration data were expressed as example (N) or percentage (%) and χ^2 test was conducted. $p < 0.05$ indicated that the difference had statistical significance.

3. Results

3.1 Comparison of Clinical Efficacy between Two Groups

The total clinical effective rate of the observation group was significantly higher than that of the control group, and the difference was statistically significant ($p < 0.05$), as shown in Table 2.

3.2 Comparison of Pelvic Floor Muscle Strength before and after Treatment between the Two Groups

There was no significant difference in pelvic floor muscle strength between the two groups before treatment ($p > 0.05$). After treatment, the grade 0 proportion of pelvic floor muscle strength in the observation group was significantly reduced, and the grade IV proportion was significantly increased. Besides, the grade 0 proportion of pelvic floor muscle strength in the observation group was significantly lower than that in the control group, and the grade IV proportion was significantly higher than that in the control group. The differences were statistically significant ($p < 0.05$), as shown in Table 3.

3.3 Comparison of the Degree of Pelvic Organ Prolapse before and after Treatment between the Two Groups

There was no significant difference in POP-Q scores (Ap or C) between the two groups before treatment ($p > 0.05$). After treatment, POP-Q scores of Ap indicated point were increased and those of C indicated point were decreased in both groups. The changes were more obvious in the observation group. The differences were statistically significant ($p < 0.05$), as shown in Table 4.

3.4 Comparison of Quality of Life between the Two Groups before and after Treatment

There was no significant difference in PFDI-20 or PFIQ-7 scores between the two groups before treatment ($p > 0.05$). After treatment, the PFDI-20 and PFIQ-7 scores were significantly decreased in the two groups, and the PFDI-20 and PFIQ-7 scores in the observation group were significantly lower than those in the control group. The differences were statistically significant ($p < 0.05$), as shown in Table 5.

4. Discussion

The pelvic floor is a collection of structures, comprised of three distinct muscle layers that have 5 distinct functions (organ support, sphincter, sexual, sump pump and lumbopelvic motor control). However, in pregnancy and

Table 2. Comparison of clinical efficacy between two groups [n (%)].

Clinical efficiency	Control group (n = 50)	Observation group (n = 50)	χ^2 value	p value
Highly effective	18 (36.00)	27 (54.00)	-	-
Effective	17 (34.00)	21 (42.00)	-	-
Ineffective	15 (30.00)	2 (4.00)	-	-
Total clinical efficiency	35 (70.00)	48 (96.00)	14.473	0.000

Table 3. Comparison of pelvic floor muscle strength before and after treatment between the two groups [n (%)].

Items		Control group (n = 50)	Observation group (n = 50)
0	Before treatment	5 (10.00)	7 (14.00)
	After treatment	6 (12.00)	1 (2.00)*#
I	Before treatment	11 (22.00)	10 (20.00)
	After treatment	10 (20.00)	9 (18.00)
II	Before treatment	19 (38.00)	17 (34.00)
	After treatment	17 (34.00)	16 (32.00)
III	Before treatment	13 (26.00)	14 (28.00)
	After treatment	14 (28.00)	14 (28.00)
IV	Before treatment	2 (4.00)	2 (4.00)
	After treatment	3 (6.00)	9 (18.00)*#
V	Before treatment	0 (0.00)	0 (0.00)
	After treatment	0 (0.00)	1 (2.00)

Note: compared with that before treatment, * $p < 0.05$; compared with the control group, # $p < 0.05$.

childbirth, with the increase of the uterus and the pelvic weight, pelvic tissues can be damaged to different degrees, which reduces the support ability of the pelvic floor structure and improves the damage coefficient of pelvic floor function [1]. Although PFMT can improve the levator ani muscle strength, pelvic floor blood circulation, pelvic floor support force, and vaginal contraction ability, it often affects the therapeutic effect because patients are unable to correct the pelvic floor muscle contraction, and have poor compliance [13]. *In vitro* magnetic wave pelvic floor treatment can promote the recovery of pelvic floor muscle contractility and improve the pelvic muscle endurance, with a wider stimulation range and deeper stimulation depth, and is a non-invasive, painless and non-invasive intervention method [14]. PFMT is a method for training the contraction of pubococcygeus muscle and has promoting significance for pelvic floor rehabilitation [15]. However, there are few studies exploring the effects of extracorporeal magnetic wave pelvic floor treatment combined with PFMT on the pelvic floor muscle strength and the degree of pelvic organ prolapse of postpartum PFD patients. The results of this study showed that *in vitro* magnetic wave pelvic floor treatment combined with PFMT had a significant therapeutic effect on postpartum PFD patients, which could effectively improve the pelvic floor muscle strength and the degree of pelvic organ prolapse, and also improve the quality of life of patients. The reasons are now analyzed as follows.

Mikuš *et al*. [16] found that PFMT could help to improve the clinical symptoms of fecal incontinence patients and affect specific physiological indicators. Mundet *et al*. [17] demonstrated that *in vitro* magnetic innervation and PFMT could effectively treat stress urinary incontinence in adult women. In this study, the overall clinical efficiency of the observation group was significantly higher than that of the control group. After treatment, the grade 0 proportion of pelvic floor muscle strength of the observation group was significantly lower than that of the control group, and the grade IV proportion was significantly higher than that of the control group. At the same time, the POP-Q scores (Ap and C) of the two groups were decreased after treatment. Compared with the control group, the POP-Q scores (Ap and C) of the observation group were lower. Comprehensive study results of Mundet and Mikuš [16,17] showed that: extracorporeal magnetic wave pelvic floor treatment combined with PFMT can effectively treat PFD patients, improve their clinical efficacy and pelvic floor muscle strength and reduce the degree of pelvic organ prolapse, and the causes were analyzed. In extracorporeal magnetic wave pelvic floor treatment, the sensitive nerve tissues were stimulated by the pulsed magnetic field, so that the proprioceptor of the pelvic floor muscle was awakened, and finally the pelvic floor muscle was exercised to improve the body pelvic floor muscle strength [18]. At the same time, external magnetic wave pelvic floor treatment is a non-invasive treatment, which can effectively treat uterine prolapse and urinary incontinence by inducing eddy current effect and stress contraction of this part and the surrounding muscles through the pulsed magnetic field [19]. PFMT mainly in-

Table 4. Comparison of the degree of pelvic organ prolapse before and after treatment between the two groups ($\bar{x} \pm$ s, m).

Items		Control group (n = 50)	Observation group (n = 50)
Ap	Before treatment	–3.02 ± 0.34	–3.06 ± 0.42
	After treatment	–2.96 ± 0.26*	2.71 ± 0.37*#
C	Before treatment	–4.62 ± 3.41	–4.70 ± 3.51
	After treatment	–5.16 ± 3.05*	–6.92 ± 3.42*#

Note: compared with that before treatment, * $p < 0.05$; compared with the control group, # $p < 0.05$.

Table 5. Comparison of quality of life between the two groups before and after treatment ($\bar{x} \pm$ s, core).

Items		Control group (n = 50)	Observation group (n = 50)
PFDI-20 score	Before treatment	80.22 ± 15.36	81.10 ± 16.13
	After treatment	25.83 ± 4.23*	18.51 ± 5.61*#
PFIQ-7 score	Before treatment	100.46 ± 27.53	101.30 ± 28.11
	After treatment	29.64 ± 4.16*	22.15 ± 4.09*#

Note: compared with that before treatment, * $p < 0.05$; compared with the control group, # $p < 0.05$.

volves the patients themselves to feel the rhythmic relaxation and contraction of the pubic–coccyx muscle group, to promote blood flow and improve microcirculation, which is of positive significance for the improvement of pelvic floor muscle strength and helps to improve the pelvic floor supporting force. At the same time, it is used to prevent the complications such as pelvic organ prolapse and stress urinary incontinence [20]. However, PFMT cannot restore the muscle function of the damaged nerves, and patients may also mistakenly use the gluteal muscles and abdominal muscle strength, which often require a long time and training intensity to achieve the ideal effect of rehabilitation treatment [21]. The combination of extracorporeal magnetic wave pelvic floor treatment and PFMT can play a synergistic role in jointly treating PFD and promoting the improvement of relevant symptoms.

Brusciano *et al*. [22] showed that *in vitro* magnetic stimulation could help to improve the life quality of patients with fecal incontinence. Aydın Sayılan *et al*. [23] concluded that PFMT could effectively improve the urinary incontinence and quality of life of patients with urinary incontinence after radical prostatectomy. In this study, the PFDI-20 and PFIQ-7 scores were both decreased after the treatment in the two groups. However, compared with the control group, the PFDI-20 and PFIQ-7 scores in the observation group were lower, which were basically in line with the results of the studies by Brusciano [22] and Aydın Sayılan [23], etc., indicating that the *in vitro* magnetic wave pelvic floor treatment combined with PFMT could effectively improve the quality of life of PFD patients. To analyze the reason: *In vitro* magnetic wave pelvic floor treatment refers to the application of pulse current after the electrodes are placed in the vagina to stimulate the receptors of the body, thereby regulating the excitability of muscles, causing passive relaxation and contraction of muscles, which can play a role in strengthening the function of the pelvic floor muscle group. In addition, there is no pain during the treatment, resulting in high safety and comfort [24]. PFMT was proposed in 1948, aiming to improve muscle tension by stretching the pelvic pubic–coccyx muscle, serving as the core means for rehabilitation of pelvic floor. It can effectively promote the contraction of urethra, vagina and anus muscles, reduce the contraction of detrusor and bladder, and exercise the coordination and perception functions. At the same time, it is characterized by simple operation, economy and high patient acceptance [25,26].

5. Limitations of Study

The limitations of this study lie in the fact that the selected sample size is small, which may cause deviations between the data in the results and the actual values. At the same time, since no long-term follow-up has been conducted, it is impossible to determine the long-term effect of extracorporeal magnetic wave pelvic floor treatment combined with PFMT on PFD patients. Therefore, it is necessary to expand the sample size and extend the follow-up time in the later stage to conduct further verification research. In addition, PFMT that does not follow best practices is not expected to yield 8× cure rate[27,28].

6. Conclusions

In summary, extracorporeal magnetic wave pelvic floor treatment combined with PFMT in patients with PFD can effectively improve the clinical efficacy, pelvic floor muscle strength, pelvic organ prolapse degree and quality of life, which is worthy of clinical reference.

Availability of Data and Materials

The datasets used and/or analyzed during the present study are available from the corresponding author on reasonable request.

Author Contributions

JX and YC designed the research study. ZS performed the research. JX and YC analyzed the data. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki. This study was approved by the Lishui People's Hospital Ethics Committee (Approval number: 20190831LS).

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Conflict of Interest

The authors declare no conflict of interest.

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